ANALYSIS OF 'PARAMETERS' OF LEARNING AND THEIR RELATIONSHIP TO SCHOLASTIC ACHIEVEMENT (AN EXPLORATORY STUDY)

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Delhi.

D.Paul.

CHAPTER 1

Introduction

Learning occupies an important place in Psychology and Education. Psychologist and Educationist have been asking themselves, what learning is, why something can be easily learned and others only with great difficulty, why we forget something easily and always remember others, what are the factors which contribute rapid and easy learning, whether the individual learn in a unique way or their are something common, whether individuals can be grouped according to their process of learning, and so on. Educationists are concerned with finding out how to teach organisms new responses efficiently and how to eliminate old ones easily. The Psychotherepist is interested with the problem of redirection of behaviour. The modern industrial and military world is emphasizing us to learn difficult tasks with the most efficient expenditure of time and energy. Psycholigist, Educationist, Physiologists have been going on with research to solve their queries and to formulate law, theory, hypothesis etc.

After reviewing their researches and findings it appears that the problem of learning occupies a central place in education and learning, although theoretical formulations of learning are widely divergent.

General Statement of Aim of the Study :

The general aim of the project is to arrive at certain objective indices of the pattern of learning in a Class room situation.

The specific objective of the research is to study the relationship between "rate of change" due to the learning a task similar to comprehension of Biological passages with their achievement in school examination particularly on Biology.

Besides the problem that have been just named the researcher is also interested to the following statements;

(1) The relationship of the total improvement in learning with the scores on first and last trial.

(2) The relationship between "true change" and the amount retained i.e. is there a tendency that an individual who has showed comparably a large amount of change will also retain comparably more amount.

(3) The relationship between the rate of learning and the amount retained i.e. whether a fast learner will retain more amount than a slow learner or vice-versa.

(4) Whether the rate of learning is independent of content of the passage.

(5) Qualitative analysis of the pattern of learning curves by which respondents can be categorized.

Specification of the relationships to be Investigated.

(1) Does the rate of learning as tested by comprehension test administered over a number of trials significantly correlate with the school examination marks ? Any significant correltion [illegible] indicate the learning process involved.

(2) Is there any relationship between scores on the first trial with the scores on the last trial ? It is an experience that some individuals do not do well in the first few months in the class as time goes on they do better than some of the individuals who do good initially.

(3) Does "true change" in the learning situation of a comprehensive task correlate with the initial and ~~total~~ Final score ? Sometimes it is said that performance in a test in a single trial does not say much about the individual who takes it but if one can measure his performance on several trials, he may get a better record of his ability which the test requires.

(4) Is there any relationship between true change and the amount retained ?

(5) Does rate of learning correlate with retention ? It is said at the time of discussing related studies that some investigators found a positive relation, some found negative relation and others no relation. The researcher wanted to investigate this problem using a comprehension task.

(6) Whether the rate of learning is independant of the passage ? Logically rate to learning should not change with the content of the task if the task calls for some mental process. The researcher wants to find whether there is any difference in rate of learning of two comprehension tasks when the subject matters are different.

(7) Can students be categorised from the pattern of learning curves and learning by parameters. Do the poor, average and brighter students learn in the same way, if not how they differ ?

A Brief Note on Related Studies.

Starting from Ebbinghaus (1885) till now a lot of work on learning have been done both in animal and human learning. Some work specially on theories of learning have been carried out in our country. But perhaps work of the nature undertaken in this study is not yet done in the country.

Dressal and Mayhew (1954, pp.243-245), in a study of the gains made by college student, in a critical thinking found a recurring pattern of large gains mady by students with low pretest scores and small gains mady by students by high protest scores. They listed several phenomena that could account for this pattern.

1. A 'Ceiling effect' i.e. the initially high scores have a reduced possibly for gain.

2. A regression effect i.e. on retesting initially low scorers tend to move up reward the mean while initially high scores tend to drop rather than gain.

3. A focus of instruction effect, i.e. instruction may be aimed at the average or below average student rather than at the able individual.

4. An effect of familiarity or unfamiliarity with terminology and concept,i.e. the test of ability to do critical thinking and the knowledge of terminiology and concepts. The initially low students may make their gain in the knowledge rather than in the ability to do critical thinking perse, while the initially high students may make their gain primarily in the ability itself.

Lord (1953) and McNemer (1958) studied the problem of true gain and Errors of measurement to remove the spurious effects resulting from errors of measurement. Lord proposed a rather simple procedure for taking account of the so called "regression effect". He took the view that the problem of whether numerically equal gains at different points of the scale are wqual is primarily one of the test construction.

Mitzel and Gross (1956), after reviewing three methods of dealing with gains (raw gain scores, achievement quotient gains and regression methods), argued for the use of co-varience analysis as the best of the available techniques.

There are also some studies in changes in variability with practice in which the present researcher is also interested.

Ryans (1939) showed that variability increased whereas according to Ehrlich (1943 b) it decreased and according Owens (1942) it remained the same with practice. Hunter (1934) prophesied that when adequate procedures become available it will be found that individual differences in degree of skill increase rather than diminish with training.

The study of acqusition curve for verbal learning made by R.A. Davis and W.C.F. Kruger may be mentioned here. R.A. Davis (1935) concluded that the verbal learning improvement with meaningless material is very erratic whereas that for meaningful material is more constant. W.C.F. Kruger said that whether meaningful or meaningless material, the patterns of acqusition curve changed as the difficulty of material was increased with easy material the curve is negative accelerated, but as the difficulty value increases the curves become linear, and with maximal difficulty the curves are positively accelerated.

In the relationship between speed of learning and amount retained, Gilletter's (1936) study claims that the assumption a rapid learner retains it for a long time is not always true. If we compare the retention of individuals who reach a criterian performance rapidly with individuals who reach the same criterian slowly, we find that the retention of the fast learners is better than that of the slow learner.

B.J.Underwoods (1954) study on "speed of learning and retention" said that there was no difference in rate of learning and amount retained.

In connection with the study about learning parameters, the names of L.R. Tucker and P.B.Allison should be mentioned here. Tucker showed in his study "Determination of parameters of a functional relation by factor analysis" (Psychometrika, 1958) that three different kinds of learning curves are needed to explain his data. There were apparently early learners, medium learners, and people who caught on to some of the ideas very late in the series of trials, so that one of the learning curves was a rapidly rising negatively accelerated curve, and the other two were inflected S-shaped curves.

R.B.Allison in his report on "Learning parameter and human abilities" (E.T.S. May, 1960) found out some common factors in measures of learning and measures of aptitude and achievement.

Defining Terms:

Learning:

The definition of learning to be adopted in this study is a general one patterned after many authors. According to Newman (1951) "Learning has to do with changes in our experiences and in our behaviour as a result of earlier responses in a similar situation". Gulliksen (1951) stated: "Broadly speaking learning is present whenever there is any relatively permanent change in an organisms behaviour which is the result of it reaction to environmental influences". He further added that the change should be sufficiently permanent to distinguish it from temporary changes such as sensory

adaptation or fatigue and "warm up" phenomena, and also that the change should be a result of the organisms' reaction to environmental influences such that the learning can be distinguished from maturation or growth. According to Ferguson learning refers to "changes" in "ability" to perform a specified task as a result of practice.

For our purposes, learning is defined as the change in performance associated with practice and not explicable on the basis of fatigue, or artifacts of measurement, or of receptor and effector changes.

When an individual's performance on a task changes with practice and with knowledge of his results, learning is presumed to have taken place and to have constituted the basis for the modification. By inference, characteristics as parameters which describe his performance are associated with and descriptive of the learning process. The parameters consist of c_0, which represents the initial level of achievement prior to learning, c_1, which represents the average rate of learning, and c_2 which indicates whether the subject was learning faster during the first half or second half of the learning task.

True Change: The change that is free from any error is called true change. The change in performance due to practice that which we get subtracting scores on different occasion, is called observed change. Now this observed change is more or less associated with chance fluctuation arising from errors of measurement. Our objective is to calculate that change where there is no errors of measurement. For

finding out the "true change", from Lord's formula is used.

According to hand:

$$G = \bar{G} + bgx.y\,(x - \bar{x}) + bgy.x(y - \bar{y})$$

G = true change.

$\bar{G} = \bar{y} - \bar{x} = \bar{y} - \bar{x}$

$\bar{y}$ = Mean of the final trial.

$\bar{x}$ = Mean of the Ist trial.

$$bgx.y = \frac{(1 - ryy^1)\, rxy\, sy/sx - rxx^1 + rxy}{1 - rxy}$$

$$bgy.x = \frac{ryy^1 - rxy - (1 - rxx^1)\, sx\, rxy/sy}{1 - r\,ny}$$

ryy^1 and rxx^1 are the reliability co-officient of measurement of final trial and initial trial respectively.

Average rate of learning:- This is debined as it is debined by R.B.Allison in his research report "Learning Parameters and human abilities" (E.T.S. May, 1960) as Ci1

$$\frac{dpit}{dt} = ci1$$

pit = observed score of the individual i on trial t

The parameter ci2 was also calculated to know whether the individual i was performing relatively better (hence, learning faster) during the first half of the learning task than in the second half. According to R.B. Allison.

$$\frac{d^2pit}{dt^2} = 2ci2$$

CHAPTER - II

GENERAL PROCEDURE OF STUDY

The research undertaken consisted of three major process which may be described broadly as follows : (1) The development of instrument for recording data. (2) The administration of the instrument. (3) Analysis of data.

A. The development of Instrument.

The Study required instruments which would be able to measure the amount of learning of the individuals, who would take the test. For this comprehension type of test were constrecad. The very first thing that comes about the construction of a test is it meaning i.e., what is meant by a "test". "A test is a pattern of Stimulas that will elicit certain responses revealing certain characteristics of the individual performing it". These pattern of Stimuli are of course organised and selected in their nature. The characteristics in question may be general intelligences numerical ability, aptitude for some specific vocation and soon. The Stimuli may be of various nature. At present the writer was interested to develop some testsment for measuring learning to comprehend. These tests were operationally defined as the set of stimuli, performence of which required understanding, analysing, synthesising and finding the relationship between ideas, concepts, facts and figures.

Collection of items :

Six passages from different Biology books and Biological Journals were selected. The very subject matter in the passages was not included in the syllabus of the respondents meant for the study but it was assumed that the basic ideas and concepts including in the passages were taught in the School. This was verified by consulting with the syllabi and teachers. Every effort was taken to avoid language effect. 30 items (questions) were constructed for each of the passages. All items were multiple choice items having 5 alternatives.According to writer multiple choice items were particularly effective in measuring inferential reasoning, reasoned understanding, sound judgement analysing and synthesing of the related ideas, concepts etc. in all of which he was interested, provided some precautionery measures were taken.

Following precautionswere taken in consideration in constructing the items.

a) Expressing the items as concisely as possible, avoiding unnecessary words, and non-functional materials which do not help to make the question clear.

b) Avoiding ambiguity resulting from vague, figurative or colourful wording or from complex sentence structure.

c) Being sure that all the responses are appropriate to the item stem and parallel in structure point of view.

d) Making each response distinctly different in the thing it refers to, or the idea it expresses.

e) Avoiding distractors which are more like each other than they are alike the correct answer.

f) Not consistently expressing the correct response more carefully and at greater length than the other responses.

g) Making certain that the pupil must read all of each response before accepting or rejecting it, i.e., making certain that the entire content of the excercise will necessarily function.

h) Making all of the responses homogeneous in their general characteristics and in external form.

i) Limiting questions to those on which substantial misinformation or common misconception are known to exist.

Besides the above precautions, one more thing was taken into due consideration. The initial choice of test items depended on the rational of the writer which was verified and modified by the (i) Introspective report of the respondents. (ii) Criticism of the three competent persons e.g. one well experienced teacher of Biology, one Psychologist and other was the guide of the research

on expert in the field of Educational and Psychological research.

Pilot Study :

Test was administered to a group of students of Class X (Biology group) in a Delhi School. They were asked to read each passages attentively for 5 min. After the time was over they were given questionnaire already constructed.Each of the Students was further asked to try to answer the questions as quickly as possible. The time taken by 90% of the individuals to complete the questionnaire was recorded to be 5 min. Students were given the same passage and requested to do as earlier. In this way 4 trials were given to them. All the 6 passages were administered to them in the same way. With the help of this study timings were fixed i.e. 5 min. for passage readings and 5 min. for answering the questionnaire for the final administration.

The students were also requested to write how they had solved the questions.

From the obtained results of the students, three out of the six passages were rejected as they could not measure comprehension as they were expected to do.Some of the questions from the selected passages were also rejected and modified to ensure letter measure of comprehension. Next step was to analyse the items.

Item difficulty :

Purpose of finding item difficulty :

In this study the writer considered only the difficulty values of items.

Difficulty value of an item is defined as proportion of correct responses. The formula that was used in the study was Guilfordis formula for corrected proportion which is ;

$$cp = \frac{Ri - \frac{wi}{k-1}}{Ri + Wi}$$

cp = Proportion of correct responses corrected for chance success.

Ri = No. of answering the item correctly.

Wi = No. if answering the item wrong.

K = No. of alternative responses

'cp' was obtained directly from p(p= $\frac{R}{T-NR}$, P= proportion of correct responses, R = No. of Right answer, T = Total no. of group + WR = No. in the group who did not reach the item) from table No. 15 of guildordi "Psychometric methods (page, 421-22)"

The using of above formula depends upon the assumption that either the examinee knew the right answer or else he guessessed at random. But due to partial and misinformation random guessing

might not always be true. It could be argued here that the departure from random guessing were somewhat compensatory and were individual matters, as a rule, and hence did not completely invalidate the use of correction formula.

Reliability :

The reliability of any measurement may logically be defined as the proportion of variance that is true variance. It can be approached from three different angles namely, stability, internal consistency and method of equivalence. The nature and the purpose of the measurement would tell what kind of reliability required and by what method it should be estimated. The present study required reliability of two things, (a) Reliability of the measuring instrument, (b) Reliability of the measurement of change. At the moment, only the reliability of the instrument would be discussed. Reliability of the measurement of true change would be discussed in subsequent chapter.

Considering the nature and the purpose of the study, it could be said here that the reliability of the instrument should be approached from internal consistency and from equivalence angle. The very assumption behind the study was that change would take place during the learning. So question of stability did not come here.

For the study of internal consistency, two different methods were used : (a) Analysis of variance method (b) K - R (20) formula. The statistical model, that was used in analysis of variance which was used to find out the reliability is ;

$$r_{tt} = \frac{V_e - V_r}{V_e}$$

r_{tt} = Reliability of the test.

V_e = Variance of the examinee.

V_r = Variance of the remainder sum of squares.

The assumptions behind the application of method were :

1) The contributions to the variance in the total sample is additive.
2) The observation within sets were mutually independent.
3) The variance within sets were approximately equal.
4) The variance within sets were from a normally distributed population.

Following were the co-efficient of reliability calculated by analysis of variance model.

a) rtt of the 1st & 2nd passages when administered in the pilani group were .78 + .79 respectively
b) rtt of the 1st & 2nd passages when dministered in the R.B.H.S gr. were .80 + 82 respectively (See table II).

Internal consistency was also measured by K - R - 20 formula.

$$rtt = \left(\frac{n}{n-1} \right) \left(\frac{q^2t \;.\; \Sigma pq}{q^2t} \right)$$

rtt = Reliability co-efficient of the test

q^2t = Total variance

p = proportion of correct response to each items.

q = 1 - p.

The assumptions that were made here were, a) All the item measure one common factor, b) average co-variance of the non-parallel items are equal to average covariance between parallel items.

Following were the calculated values of reliability by K.R. 20 formula;

1) 'rtt' of the 1st and 2nd passage when they were administered to pilani gr. was .82 + .84 respectively.

2) 'rtt' of the 1st and 2nd passage when administered to the R.B.H.S. gr. was .85+ .86.

It should be noticed here that the values of 'rtt'obtained from analysis of variance method and by K-R-20 formula were not different very much which was expected from the theory

AS the two passages were found to be parallel. Their correlation ~~combination~~ would give us reliability co-efficient from the equivalent approach. The obtained values, of co~~m~~rrelation co-efficient were as follows :-

'r_{12}' when administered to the Pilani gr. and R.B.H.S. gr came to be .70 + .74 respectively.

Validity :

Validity information indicates to the test were the degree to which the test is capble of achieving certain aims. Tests are used for several types of judgement, and for each type of judgement, a somewhat different validation is involved.

There are generally four types of validity, a) content validity b) Predictive validity c) Concurrent validity, d) Construct validity.

In this study the writer was interested in construct validity as he wanted to know whether the test could measure learning Comprehen

Construct validity is evaluated by investigating what Psychological qualities, a test measures, i.e., by demonstrating that certain explanation construct to some degree for performance of the test. Construct validity requires both logical and empirical approach.

It was said at the time of discussing pilot study that the subjects were asked to describe the steps they had followed before answering question. From their responses it was observed that most of the subjects responded after comprehending the ideas, concepts

etc. underlying the passages and if the same problem is given over and over again learning would take place. Expert judges judgement was also taken in consideration for the validity of the test. There were three judges. When at least two of three judges had the same opinion about the item that it measured learning to comprehend, the item was kept in the test otherwise rejected. The items were also discussed amongst a group of research scholars whose suggestion were duly considered.

Thus items were finally ~~bared~~ based on, a) Subject's response b) judges opinion, c) Researcher's rational and other research workers opinion.

Empirical verification of the validity was not taken into consideration as there was no external standard criterian.

This was all about the development of the instrument then came the question of administration of the tools prepared.

B. Administration of the tools :

Subject :

The experimental sample consisted of two groups of 20 individuals each. One of the groups consisted of 20 students of Class X of R.B.H.S. School. New Delhi. They were science students having Biology as one of the main subjects. The age of students varied from 12 yrs. to 16 yrs. and most of them belonged to middle Class family.

The other group consisted of 20 pre-medical Students of Pilani University, Rajasthan. They were between 15 to 20 yrs. old and majority of them belonged to upper middle class family.

A question could be asked here why the research had gone to Pilani for his data collection.

Actually the research was interested to select two groups, one from Class X and another from Class XI to see their performence in the comprehension task. But he could not get any student of Class XI from Delhi as they had examination. Then he went to Pilani to collect data from the student who had just passed Higher Secondary Examination and entered into medical College.

The testing Schedule :

The writer went to the different institutions to seek co-operation both from the authorities and students. Being assured of co-operation from both the sides the writer requested the Student to appear in the test in a particular day. Students came on the fixed day and the learning task was given to them. Before administrating the test. Sufficient verbal instruction was given to them explaining what to do, how to carry out the task, how to answer the question etc. When all of them became ready to take the, test, the experimenter proceeded as follows.

1) The subjects were asked to read the passage for 5 min.

2) After the fixed time was over, the passages were taken away and the students were supplied with questionnaire. They were also asked to answer the questions within 5 min.

3) In the same way the students were given the same passage and ~~next~~ questionnaire for 8 trials.

4) All of them were requested to write what they felt after completing the experiment.

5) Next day they were given only the questionnaire without the passage for one time only.

6) One day after, the same gr. students were given the ~~same~~ other passage and worked to proceed as they had proceeded previous experiment.

7) Same procedure was followed to the other gr. of Students.

Scoring procedure.

The answer papers were scored with all or none principal i.e. for correct response 'I' mark was given and for incorrect or non-response no mark was given. School Exam. Score was obtained from the respective institution and only scare obtained in Biology was considered.

CHAPTER - III

COLLECTION OF DATA

This chapter will present how and what date were collected.

A. Computation of average rate and curvature parameter of learning.

* At the time of defining average rate of learning, it was said that -

$$\hat{p}it = Pio + Pi\ I + Pi2, \quad ..... \quad (1)$$

and define as an error term

$$eit = Pit = -\hat{P}it = Pit - Pio - piI - pi2, \quad .... \quad (2)$$

Where

Pit = Observed Score of individual i on trial t,

$\hat{P}it$ = Theoretical Score of individual i on trial t

$Pio = Cio$ = Initial ability for individual i

$Pi1 = Ci1t \qquad (t = 1,2,3, ..., k),$

$Pi2 = Ci2 \left[(t - 1/2K)^2 - 1/4K^2 \right] \quad (t = 1,2,3, ...,K).$

If the basic equation is rewritten

$$\hat{P}it = Cio + Ci1t + Ci2 \left[(t + - 1/2K)^2 - 1/4K^2 \right] \quad ... \quad (3)$$

Then Ci 1 and Ci2 may be defined analogously to speed and acceleration in terms of first two dirivatives of equation (3)

with respect to t as follows :

$$\frac{dpit}{dt} = Ci\ 1 + 2ci2\ (\quad - \tfrac{1}{2}K),$$

and

$$\frac{d^2pit}{dt^2} = 2ci2$$

The values of $\frac{dpit}{dt}$ at mind-trial (where t = 1/2K) in simply ci1 and this represents the rate of performance (hence learning) at mid trial. It[24] can also be shown that ci1 is the average rate of learning over the K trials.

The parameter Ci2 is proportional to the Second divivative of equation (3) and in terms of the analogous relation to acceleration this parameters indicates whether individual i was performing relatively better during thefirst half of the learning task than in the Second half. From equation (3) it can be deduced that if Ci2 is negative the subject was learning more quickly during the first half of the learning task and is positive of the subject was learning more quickly during the Second half.

The method of least squares was employed to Calculate the learning parameters (co, c1, c2), Such that the sum of the squares of the error term represented by equation (2) would be set at a minimum.

This method may be expressed in matrix notation as follows :-

let $C \equiv \left\| C_0 : C_1 : C_2 \right\|$ .... (4)

$$X = \left\| \begin{array}{cccc} 1 & : 1 & : 1 & : 1 \\ 1 & : 2 & : & : K \\ 1-x & : 4-2K & : t^2-tk & : 0 \end{array} \right\| \quad .... \quad (5)$$

($t = 1, 2, 3, \ldots\ldots, K$)

$\hat{P} = \left\| P_1 : P_2 : \ldots\ldots \hat{P}t \ldots\ldots : \hat{P}_k \right\|$ *

Then $\hat{P} = CX$

which is the matrix equivalent of equation ... (3)

The learning parameters were obtained from the table given by R.B. Allerin in his research report published in E.T.S. May, 1960. Here Co was taken as 0 and no. of trials were taken as 8.

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* The equation were taken from R.B. Allison's Research report (Learning parameters and human abitition) Published in E.T.S. May 1960.

B. Estimation and reliability of true change.

Lord's formula of "Estimating & reliability of true change" was taken into consideration in finding them.

According to Lord.

$$G = (\bar{Y} - \bar{X}) + bGX.Y(X-\bar{X}) + bGY.X(Y-\bar{Y})$$

where

$$bGx.y = \frac{(1-rYy')rxy\ Sy/Sk-rxx' + r^2xy}{1-r^2xy}$$

$$bGy.X = \frac{rY_y' - r^2xy - (1-rxx')\ SXrxy/Sy}{1-r^2xy}$$

Where

rxx' = reliability co-efficient of 1st trial seare which was found out by corelating 1st trial's Scores of the two passages

ryy' = relability co-efficient of 8th trial score which was found out by corelating 8th trial's scores of the two passages

Sx = S.D. of the 1st trial scores.

Sy = S.D. of the 8th trial scores

rxy = Correlation between 1st trial score and 8th trial score.

This formula assumes that the true change has a rectilinear regression on "X" + "y". For calculating reliability of estimated change, Lord's formula was taken which is as follows .

$$rgg' = \frac{S^2Yryy' - 2SySxrxy + S^2xrxx'}{S^2y - 2SySxrxy + S^2x}$$

$r_{gg'}$ = Reliabilityof true change

Other symbols are same as before

C. Compulation of Co-efficient of correlation. For computing co-efficient of correlation, spearman's rank order method was applied.

$$R = 1 - \frac{6 \ \Sigma D^2}{N(N^2-1)}$$

R = Rank order correlation.

D = Difference between two ranks.

N = No. of individuals.

The reason of adopting this formula were as follows :

(1) It does not rest on the assumption of normality, that is being measured.

(b) When the sample size is 20 or less the correlation value.- does not differ from parametric methods like product moment method.

(c) It is easy and time saving method.

CHAPTER - IV

RESULTS AND INTERPRETATION

This section will deal with the results and interpretation of the findings.

The reader is requested to look the following interpretations restricted to the present experiment.

A. About the test.

Difficulty values

Result :- The range of difficulty values of questions in passage No. 1 and 2 in connection with pilani and R.B. H.S. group were found to be in the rang of 33 to 62, 35 to 52 32 to 56 and 32 to 50 in first trial and 74 to 96, 62 to 94, 66 to 96 and 68 to 88 in 8th trial (see table No. 5, 6, 7 & 8).

Interpretation : The homozeneity of the questions decreased in the 8th trial in comparison with the 1st trial with ~~report~~ regard to difficulty value.

Reliability :

Result : The reliability of the instruments were found out by, Analysis of variance method, K-R-20 formula and by

parallel tests about all of which much had been discussed in the earlier chapter (chap.2). The r~~m~~anage of reliability co-efficient varied from .78 to .82 (analysis of variance approach .82 to .86 (K- R -20, formula) and .70 to .76 (parallel tests) (see table No. 11).

Interpretation : The reliability of the instruments were established. The value of the reliability co-efficient calculated from analysis of variance method and K-R-20 formula were more or less identical which was supported by the theory.

Reliability of estimated change.

Result : The reliability of estimated change was calculated by the help of ~~Lords~~ Lord's-formula which was discussed at length in the earlier chapter. The range of coefficient of reliability was found to be .62 to .70 (see table 13).

Interpretation : The estimated change that had been been found out could be accepted as reliable.

Validity :

The validity of the instrument could not be ~~assumed~~ assessed by correlating the scores with measures on a standard

criterian as no such criterian was available.

The measuring instrument, could however be considered valid as regards its construct because as pointed out earlier that researcher's rationals, subjects introspection, expert's judgement were taken into consideration in the development of the instrument.

Interpretation : The researcher had to be satisfied with this indirect measure. He could not verify it empirically due to non-availability of standard critirian.

B. About the actual experiment.

For the purpose of study 48 correlation co-efficient were calculated (see table 14).

The results were categorised and interpreted as follows.

(1) Result : The correlation between average rate of learning and school exam. marks was found to be in the range of .44 to .58 (see table 14).

Interpretation : All the 'r's were significant at .05 level. As the correlation co-efficient could not be regarded as high, it could be concluded that average rate of learning to comprehend might give more information besides school success and

~~the ability required in School success is not highly related with the power of comprehension.~~

(2) The correlation between the scores on 1st trial and 8th trial was between .17 to .41 (see table 14).

Interpretation : None of the correlations was significant at .05 level. On the basis of result it could be said that performence in the 1st trial was not a good predictor of the latter performance.

(3) Result : The correlation between scores on 1st trial retention was in the range from -.03 to .68 (see table 14).

Interpretation : From the above result it could be said that all 'r,R's except ~~change~~ one (Pilani gr. in 1st passage) were significant either at .05 level or .01 level. ~~gm~~ It Seemed to the writer that insignificant correlation in the case of Pilani gr. Passage No.1 was due to the some unexpected situation. It would not be unjustifiable to interpret from the obtained result that higher the initial score, higher would be the retention.

(4) Result : The range of correlation between initial scores and true change was form -.10 to .33 (see table 14).

Interpretation : None of the above correlations was significant at .05 level. So seeing the scores on 1st trial, it would not be

justifiable to predit one's future change in learning comprehension task.

(5) Results : The range of correlation of School Exam. scores with 1st and 8th trial were between .30 to .50 + .48 to .62 respectively (see table 14)

Interpretation : Except only in the one case (pilani gr. passage 1) all correlations were significant either at .05 level or .01 level. The values of r_8S.E.S. were higher than values of r_1S.E.S. which showed scores on 8th trial was a better predicter of school success than scores on 1st trial.

(6) Results : The correlation between the scores on 8th trial and retention was in the range of .75 to .92 (see table 14).

Interpretation : Here all correlations are significant at .01 level. This was expected because retention directly varied with the no. of practices to a certain limit. It was also expected if students really comprehended the passages they would be able to retain more than if they did not comprehend.

(7) Result : Correlations between scores on 8th trial and true change were in the range of .58 to .82 (see table 14)

Interpretation : All "r_8t_c" were significant at .01 level.

Above results showed that true change could better be predicted by scores after several trial than scores in the 1st trial.

(8) Result : Correlations between retention and true change lay between .60 to .78 (see table 14) .

Interpretation : All 'rate's were significant at .01 level. If it is a fact that retention is also a factor of future success, then without measuring retention, we can say something about the success from his true change.

(9) Result : The correlation between average rate of learning and retention was in the range of .65 to .74 (see table 14)

Interpretation : All of the above correlations were significant at .01 level. On the basis of above result it would be legitimate to interpret that higher the average rate of learning higher would be the retention in comprehension task.

(10) Result : The correlation between curvature parameter of learning (c_2) and retention lay in the range of .38 to .62. (see table 14).

Interpretation : Two of the four correlations were significant at .05 level other two were not significant even at .05 level. Nothing could be said about "r_RC_2" from the study.

(11) Results : Correlations between true change and school Exam. marks were ranging from .44 to .49 (see table 14)

Interpretation : All the above correlations were significant at .05 level on the basis of above results it could be interpreted that true change might give more information besides success in school.

(12) Result : The correlation of average rate of learning between two passages and for the two groups were .62 & .68 (R.B.H.S. gr. & Pilani gr, table 16).

Interpretation : Both the two correlations were significant at .01 level. It said the stability of measured c_1 (average rate of learning) in comprehension task.

(13) Result : Correlations of curvature parameter of learning between two passages and for the two groups were found to be .55 & .58.

Interpretation : The above two correlation co-efficient were significant at .01 level. Like the above interpretation it said the stability of measures of C_2 .

(14) Result : According to the learning curves (Fog. 1) individual could be categorised into 6 group.

a) Low start ended in low level

b) Low start ended in average score

c) ~~low~~ Low start ended in high score.

d) Average start ended in Average score

e) Average start ended in high score

f) High start ended in high score.

Interpretation : Writer was not able to say what group of student could be called ~~last~~ best as at present there was no external criteria with which his conclusion could be validated. Some may think that the gr. who started high and also ended in high is the best gr. But according to writer the gr. of student though started low but ended in high score in the same trial could be considered the best gr. The reason behind it was that they had learned more in the same time.

CHAPTER - V

LIMITATIONS AND SUGGESTIONS

A. Limitations.

The writer had to accept the following limitations of the study.

Firstly, Nothing had been done about the Selection of sample. Students who were willing to participate in the experiment, formed the sample.

Secondly, the sample size was small so nothing could be said about the generalisation of his findings.

Thirdly, the assumptions behind the applying of Lords' formula in measuring, reliability of estimated change was doubtfull as rectillinear regression on x + y was difficult to accept.

Forthly, learning curves & curves for the difficulty valves for all the cases could not be drawn due to the lack of time.

Fifthly, During the experiment some students expressed fatigue, boredom (in spite of the best effort on the part of experimenter not to let them occour) which might hamper some findings.

B. Suggestions

The present study was an exploratory study, so there is enough scope to verify and modify, if necessary of the present

findings. Importance should be given in selection of sample and their size.

The future researches may carry out the same kind of experiment using different type of task and using different to school subject e.g., language, physical science etc. They may also validate the findings by checking performance of the individual selected on the basis of this kind of experiment in practical field.

CHAPTER - VI

SUMMARY AND IMPLICATIONS

A. Summary.

The purpose of the study was to find out the retionship among average rate and curvature parameter of learning, School Exam. marks, retention and true change.

The instrument consisted of ~~three~~ two comprehension type passages containing Biological concepts & facts. 15 multiple choice questions each containing 5 alternative responses were constucted for each of the passages.

The reliability of the instrument was computed by different method for different purposes and the range of reliability co-efficients varied from .65 to .85.

Validity was considered by the respondent's i~~mp~~ntrospection, expert's judgement and researcher rational.

The sample consisted of two groups of 20 individuals each. One of them consisted of 20 pre-medical students of Pilani University and the other was students of Class X of R.B.H.S. School, New Delhi, having Biology as one of the main papers.

The subjects were given 8 trials to answer the question of each passages. They were requested to answer the questions of 2 selected passages given to them in two different days.

The amount of retention of the respendents was also

measured by giving the answer-sheet without passage.

From the data obtained from the respondents several statistical computations were done. e.g. average rate of learning (c_1), curvature parameter of learning (C_2), true change, retention, scores on different trials etc. The school Exam. scores were obtained from their respective institutions. The data were statistically treated which gave the following findings.

(1) Average rate of learning correlated significantly with school Exam. scores but correlation co-efficient was not high.

(2) Scores on 1st trial did not significantly correlate with scores on 8th trial.

(3) Scores on 1st trial had a low but significant correlation with retention.

(4) True change did not correlate significantly with the scores on 8th trial.

(5) Scores on 8th trial had a low but significant correlation with the school.Exam. scores. The co-effecient of correlation was more than the correlation co-effecient between cores on 1st trial & school Exam. scores.

(6) Retention scores highly correlated with scores on 8th trial.

(7) True change highly correlated with scores on 8th trial.

(8) True change highly correlated with retension scores.

(9) Average rate of learning highly correlated with the retension scores.

(10) There was a low but significant correlation between curvature parameter of learning and retention scores.

(11) True change had a low but significant correlation with school Exam. scores.

(12) Average rates of learning of the two independant passages were highly correlated.

(13) Curvature parameters of learning of the two indpendant passages had a significant correlation.

(14) Student could be categoriesed with 6 categories e.g., low initial recovers ended in low final scores, low initial ~~recovers~~ scores ended in average final scores, low initial scores ended in high final scores, average initial scores ended in average final scores, average initial scores ended in high final scores, & high initial scores ended in high final scores.

B. Implications.

As the study was an exploratory one and with limited sample & size nothing could be genaralised hence the writer felt difficult to say anything with confidence about its implications. If the further extensive studies can prove researcher findings correct, it may be argued that data given by subjects after being experimented for several times will be a better predictor of future performance.

This method may be used in case of selection for higher education, scholarship talent~~etc~~. etc

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TABLE - 9. Mean and S.D. of observed score in T_1 and T_8

Passage →	1				2			
	Mean		S.D.		Mean		S.D.	
group ↓	T_1	T_8	T_1	T_8	T_1	T_8	T_1	T_8
Pinali gr.	6.50	11.85	1.3	2.72	4.40	10.50	1.20	2.62
R.B.H.S. group	4.10	11.25	1.7	2.80	3.35	9.90	1.30	3.10

TABLE - 10. Test of Significance of means and variances between Passage No. 1 and 2.

	't'Between Passage 1&2 at 19 df in 1st trial.		'F'max between passage No. 1 & 2 at 19 df in K = 2	
	T_1	T_8	T_1	T_8
Pilani gr.	1.56*	.50*	1.17*	1.04*
R.B.H.S group	.33*	.46*	1.17*	1.10*

* = Not significant at .05 level of Significance.

TABLE . 11. Reliability of instruments by different method.

	Analysis variance Method.		K.R.20 Formula		Equivalence Method
	1st Passage	2nd Passage	1st Passage	2nd Passage	[illegible]
Pilani Group	.78	.79	.82	.84	.70
R.B.H.S group	.80	.82	.85	.86	.74

TABLE - 12. Data for calculation of True change.

	ryy		rxx		rxy		Sy		Sx	
	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Final gr.	.77++	.82++	.68++	.70 ++	.38*	.48*	2.72	2.62	1.30	1.20
R.B.H.S gr.	.79++	.79++	.74++	.74 ++	.42*	.41*	2.80	3.10	1.70	1.30

ryy ryy = Reliability co-efficient of final measurement.

rxx = " " of 1st trial

Sy = S.D. of the final trial.

Sx = " " " 1st trial

++ = Significant at .01 level

* = Not significant at .05 level.

TABLE - 13. Reliability of the estimated change

	Passage 1	Passage 2
Pilani	.65	.70
R.B.H.S.	.62	.64

TABLE - 14. Table of Correlation co-efficient.

Correla-tions.	Passage - 1		Passage - 2	
	R.B.H.S. group	Pilani Gr.	R.B.H.S. Gr.	Pinali Gr.
r_{18}	.41 *	.17 *	.40 *	.37 *
r_{1R}	.50 +	~~-.30~~ -.053 *	.47 *	.68 ++
$r_{1S.E.S.}$	.50 +	.45 +	.30 *	.49 +
r_{1te}	-.10 *	.33 *	.15 *	.27 *
r_{8R}	.84++	.75++	.92++	.89++
$r_{8S.E.S.}$	.52++	.48 +	.62++	.52 +
r_{8te}	.58++	.82++	.77++	.68++
rRC_1	.72++	.65++	.74++	.66++
rRC_2	.51 +	.40 *	.38 *	.62++
$rteS.E.S.$	.48 +	.44 +	.46 +	.49 +
$rC_{1S.E.S.}$	.51 +	.44 +	.58 +	.48 +
rRte	.72 ++	.78 ++	.60 ++	.60 ++

r_{18} = Correlation co-efficient between 1st & 8 trial,

r_{1R} = " " " 1st trial & retention

$r_{1S.E.S.}$ = " " between 1st trial and School Exam.Score

rite = Correlation co-efficient between true change and 1st trial

r8R = " " between score on 8th trial and retention

r8c = " " between score on 8th trial and ~~School Exam. score~~ true change

rRt_c = " " between retention and true change

rRc_1 = " " between retention and average rate of learning.

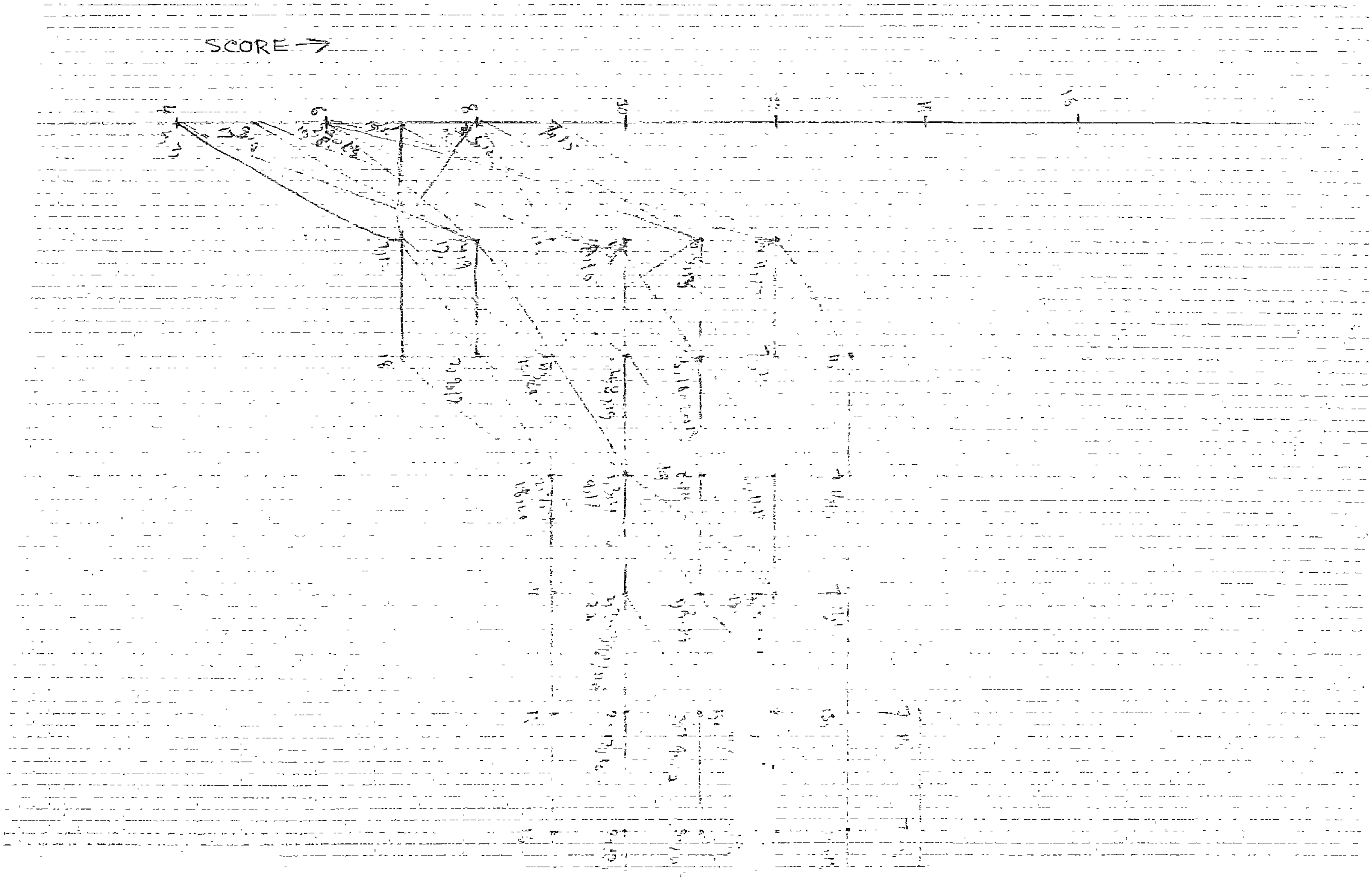
rRC_2 = " " between retention and curvature parameter of learning

$rC_{1S.E.S.}$ = " " between average rate of learning and school Exam. scores.

++ = Significant at .01 level.

+ = " " .05 "

* = Not significant at .05 level.



SCORE →
4
6
8
10

" STOMACH AND DIGESTION"

A considerable amount of digestion occurs in the stomach. The cells lining the stomach secrets gastric juice, which contains an enzyme, pepsin and hydrochloric acid. The hydrochloric acid provides the PH, that is necessary for the protein digesting work of the pepsin.

A nice problem is raised here. Since the gastric juice is a powerful protein digesting fluid, why does it not digest the stomach itself, which is made mostly of protein? Though much of it is not yet known, one of the factors involved is that certain cells of the lining of the stomach secrete mucus. This coats the insides of the stomach and makes it difficult for the gastric juice to attack the wall cells. Strong emotions (Fear, Anger) at meal times can inhibit the secretion of mucus. Unhappily the protective mechanisms do not always work; the stomach does digest itself at times. The result is an ulcer. The chemical work of the stomach is faciliated by its muscular activity. Its walls contract and relax, and these movements help to mix the gastric juice and the food, thus helping enzymatic digestion. But what cause gastric juice to be secreted? The answer is the following. When food is in mouth, the nerves in the checks and ~~tounge~~ tongue are stimulated. These carry messages in the form of nerve impulses to the brain. From the brain [illegible] go. then pass to nerves that extend to the wall of the stomach, where they stimulate the gastric glands. As a consequence, there is some gastric juice in the stomach when food arrives. When the food touches the stomach more gastric juice is secreted. Again the amount of secretion of gastric juice will greatly depend upon the amount of protein that is present in the food. During digestion the huge protein molecules are hydrolised into smaller molucules. These smaller molecules have a specific stimulating effect on some of the cells lining the stomach. They stimulate the cells to secrete a substance called gastrine. Gastrine enters the blood system and is distributed to all parts of the body, including the stomach. Here it has the specific effect of stimulating the cells of the stomach to secrete more gastric juice. Gastrine is a

9. Among four male children born out of a colour blind man and a normal eyed femal

(a) All the four children will be colour blind.
(b) Three will be colour blind and one will be normal eyed.
(c) Two will be colour blind and two will be normal eyed.
(d) One will be colour blind and three will be normal eyed.
(e) None will be colour blind.

10. In the question of 4 if the child received both the genes for baldness, he will develop:

(a) Bald if the child is female.
(b) Bald if the child is male.
(c) Normal hair whatever the sex may be.
(d) Bald in whatever the sex may be.
(e) Cannot be said from the given passage.

11. The blood type of a man would be "O" if he received:-

(a) A recessive 'A' gene from one parent and a dominant 'O' gene from the other parent.
(b) A recessive 'B' gene from one parent and a dominent 'O' gene from the other parent.
(c) A dominent 'O' gene from one parent and a recessive 'AB' gene from the other parent.
(d) A recessive 'A' gene from one parent and a recessive 'B' gene from the other parent.
(e) None of the above.

12. A daughter may inherit Hemophilia disease if:

(a) Her mother suffers from Hemophilia and father does not.
(b) Her father suffers from Hemophilia and mother does not.
(c) Her father suffers from Hemophilia and mother does not but carrier.
( ) Her mother suffers from Hemophilia and father does not but carrier.
(e) Cannot be said from the given passage.

13. A 'B' blood type individual will receive:

(a) A dominent 'B' gene from one of the parents and a recessive 'A' gene from the other parent.
(b) A dominent 'B' gene from one of the parent and a recessive 'AB' gene from the other parent.
(c) An 'O' gene from one of the parents and a dominant 'B' gene from the othe parent.
(d) A dominant 'AB' gene from one of the parent and recessive 'A' gene from other parent.
( ) Cannot be said from the given passage.